



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/896,363	06/28/2001	Hong-Qiang Lu	LSIIP167/01-206	2235

7590 11/19/2003
LSI Logic Corporation
1551 McCarthy Boulevard, M/S D-106
Milpitas, CA 95035

EXAMINER

TOLEDO, FERNANDO L

ART UNIT	PAPER NUMBER
----------	--------------

2823

DATE MAILED: 11/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.		Applicant(s)	
	09/896,363		LU ET AL.	
	Examiner		Art Unit	
	Fernando Toledo		2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 August 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 and 21-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 21-24 is/are rejected.
- 7) ☒ Claim(s) 7-14 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 June 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
2. Claims 1 – 3, 5, 21 and 23 – 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. (U. S. patent 6,486,059 B2) in view of Subramanian et al. (U. S. patent 6,465,889 B1 and in view of Sundrarajan et al. (US Patent Application Publication US 2002/0027286 A1).

In re claims 1, 3, 23 and 24, Lee discloses, in the U. S. patent 6,486,059 B2; figures 1A – 2G and related text depositing a first barrier layer 38 containing silicon carbide on a surface located to control electrical leakage from a conductor; depositing a second barrier layer 40 directly on top of the first barrier layer; forming a first low-k dielectric layer 362 over the second barrier layer; and depositing a photoresist material 44 to form a photoresist layer above at least a portion of the first low-k dielectric layer.

Lee does not show wherein the silicon carbide layer contains nitrogen. Lee also does not show wherein the second barrier layer is a nitrogen-free barrier layer.

Sundrarajan, in the US Patent Application Publication US 2002/0027286 A1; figures 1A – 2B and related text, discloses that SiCN (i.e. silicon carbonitride) has low leakage current and is effective in preventing the migration or diffusion of metal or copper atoms through the SiCN layer (Abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the first barrier of Lee with SiCN instead of just SiC, since, as

taught by Sundrarajan, it has low leakage current and is effective in preventing the migration or diffusion of metal or copper atoms.

Lee in view of Sundrarajan does not disclose wherein the second barrier layer is a nitrogen-free barrier layer.

However, Subramanian, in the U. S. patent 6,465,889 B1; figures 1 -- 8 and related text, discloses that ARC layers (like the one disclosed by Lee) can be formed of nitrogen-free compounds such as SiC, since they improve damascene interconnection structures (Abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the second barrier layer of Lee with SiC since, according to Subramanian, SiC layers improve the interconnection structures of damascenes.

3. In re claim 2, Lee discloses further including patterning, and etching the photoresist layer to form a photoresist mask (Figure 2A).

4. In re claim 5, Lee in view of Sundrarajan, discloses wherein depositing a first barrier layer containing silicon carbide and nitrogen includes using PECVD process and one of NH_3 , N_2 and N_2O as a chemical precursor to supply nitrogen (Abstract of Sundrarajan).

5. In re claim 21, Lee in view of Sundrarajan and Subramanian does not disclose, wherein the thickness of the second barrier layer is approximately 25% of the thickness of the first barrier layer.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the second barrier thickness approximately 25% of the thickness of the first barrier layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill

in the art. *In re Aller*, 105 USPQ 233. In addition, the selection of thickness, is obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996)(claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and *In re Aller*, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious). Note that the specification contains no disclosure of either the critical nature of the claimed thickness or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen thickness or upon another variable recited in a claim, the Applicant must show that the chosen thickness is critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

6. Claims 4, 6 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee in view of Sundrarajan and in view of Subramanian as applied to claims 1 – 3, 5, 21 and 23 – 24 above, and further in view of Law (U. S. patent 6,338,874 B1).

In re claims 4 and 22, Lee in view of Sundrarajan and in view of Subramanian, does not disclose wherein the process tool used to deposit the first barrier layer is used to deposit the nitrogen-free barrier layer.

However, Law, in the U. S. patent 6,338,874 B1; figures 1 and 2 and related text, discloses that this process (i.e. one chamber process) eliminated one or more transfers of the large substrates between reaction chambers (Column 2, Lines 10 – 12).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the two barrier layers of Lee in view of Sundrarajan and Subramanian in the same chamber, since as taught by Law, it eliminates one or more transfers of the large substrates between reaction chambers.

7. In re claims 6 and 22, Lee in view of Sundrarajan, Subramanian and Law discloses wherein depositing a nitrogen-free second barrier layer includes the PECVD process recited in claim 5 and turning off the supply of nitrogen.

Claim Objections

8. Claims 7 -- 14 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

9. Applicant's arguments with respect to claims 1 – 6 and 21 – 24 have been considered but are moot in view of the new ground(s) of rejection.

Application/Control Number: 09/896,363
Art Unit: 2823

Page 6

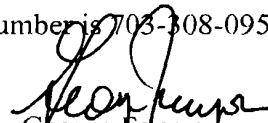
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fernando Toledo whose telephone number is 703-305-0567. The examiner can normally be reached on Mon-Fri 8am to 4pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7382.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.


FToledo


George Fourson
Primary Examiner
Art Unit 2823